

## CRES-NOAA-05

Temporal and spatial variability in the composition, abundance and distribution of juvenile corals in La Parguera



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# WORLD-WIDE REEF DECLINE

- Serious declines in coral cover, diversity and habitat structure (Pandolfi et.al. 2003).
- In the Caribbean region, diseases, and overfishing have been identified as major contributors to this degradation (Weil, 2004; Burke et.al. 2004).
- Resilience may be affected by the synergistic effect of natural and anthropogenic hazards (Bellwood, et. al. 2004; Weil, 2004).



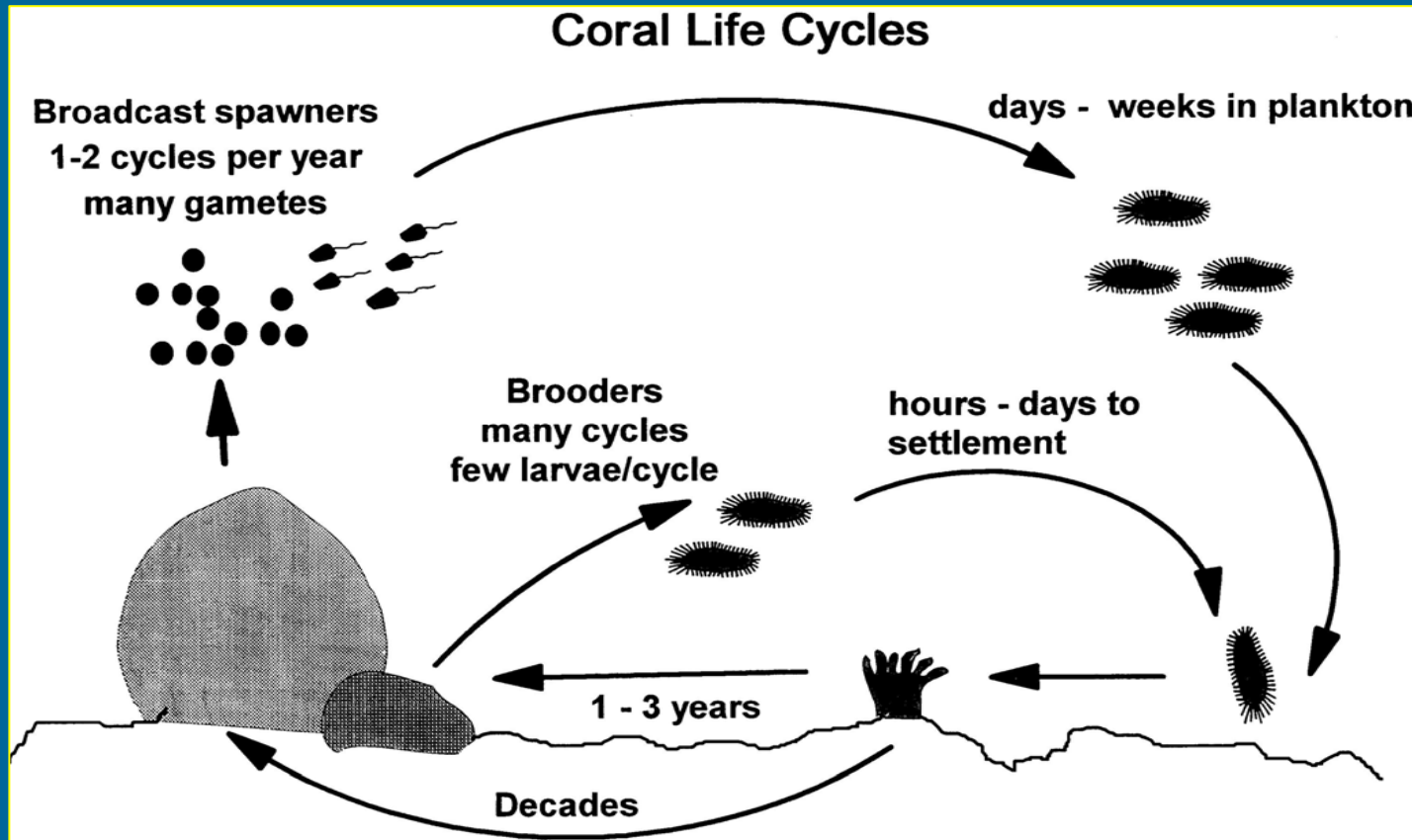


## WORLD-WIDE REEF DECLINE

- This degradation will not only affect the integrity of these important ecosystems but also the health, safety, and livelihood of the human societies that depend on them (Burke et.al. 2004)
- System recovery may ultimately depends on the supply of larvae and survivorship of recruits to replace declining populations.
- Studies to understand the reproductive biology and ecology (dynamics) of coral (other reef organisms), dispersion, recruitment and survivorship are important today (Szmant, 1996; Edmunds, 2004).

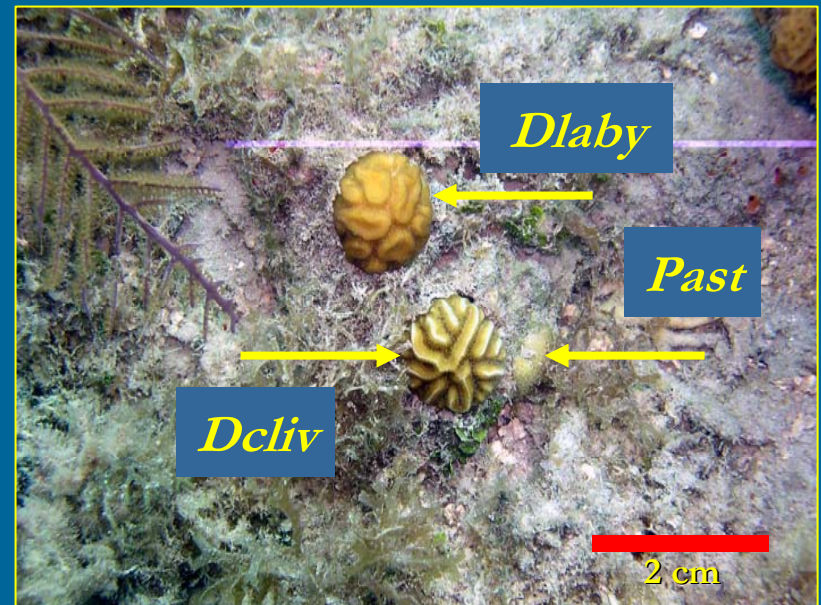
# Reef coral life cycle

- Population dynamics and life cycles of corals are more complex due to their modular nature (size vs. age) and the high diversity of reproductive strategies.



# Recruitment

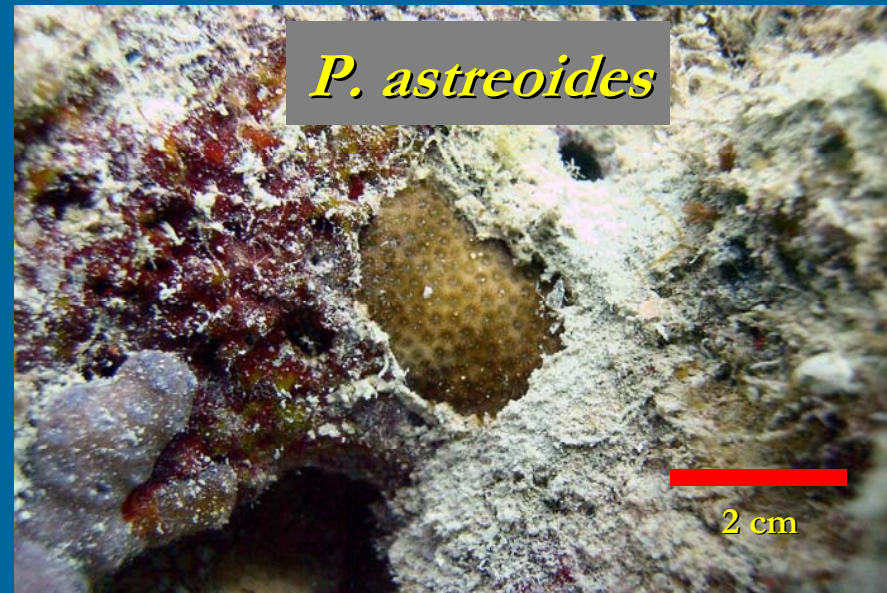
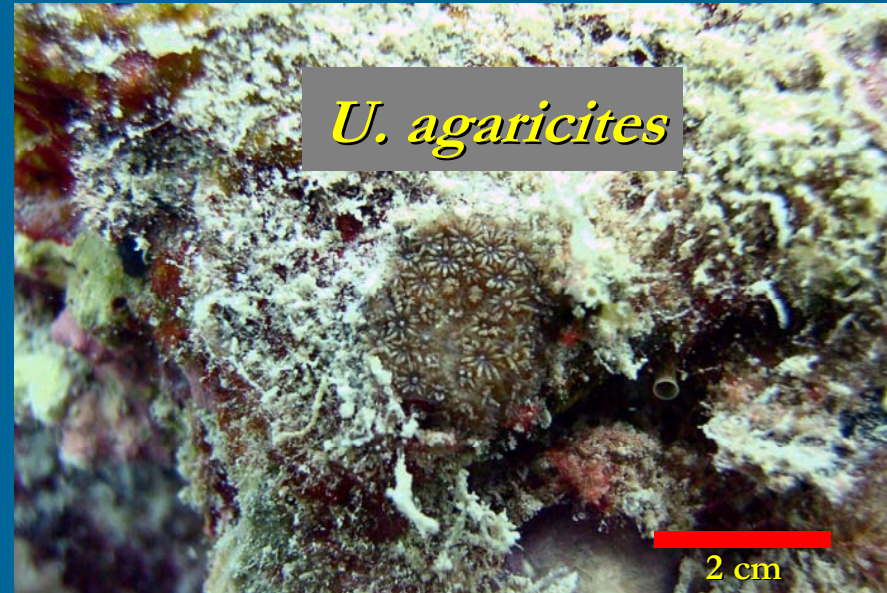
Stage at which newly grown individuals become part of the community (Richmond, 2001). Individuals large enough to be detected in the field that settle on coral rock made by different species (Wallace, 1985; Hughes and Jackson 1985).





# Recruitment

- Common belief that recruitment of reef-building species is low in Caribbean reefs.
- In general, in the Caribbean the abundance and survival of juvenile colonies seem to be higher :
  - at intermediate depths
  - areas of higher structural complexity

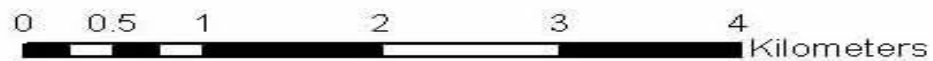


# Objectives

- Characterize the abundance, composition and distribution of juvenile corals in 9 reefs off La Parguera
- Examine the relationship of composition, abundance and distribution of juvenile colonies with that of adult corals, other biological groups, and the habitat spatial complexity.
- Assess the spatial (depth intervals within reefs, across reefs and zones) and temporal (seasonal, yearly) variability in recruitment and survivorship rates of juveniles of the major reef building species.

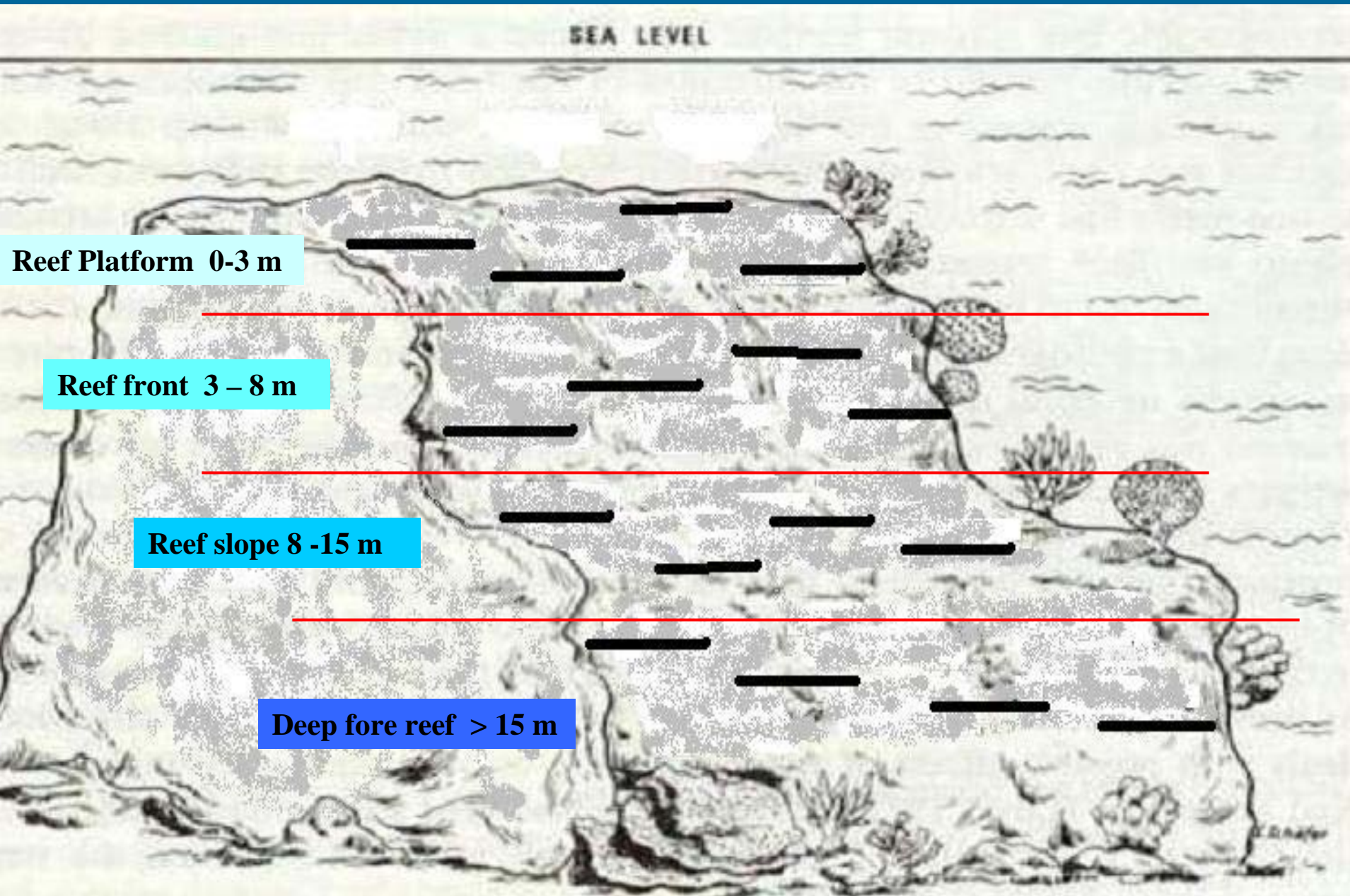


**Study Sites**



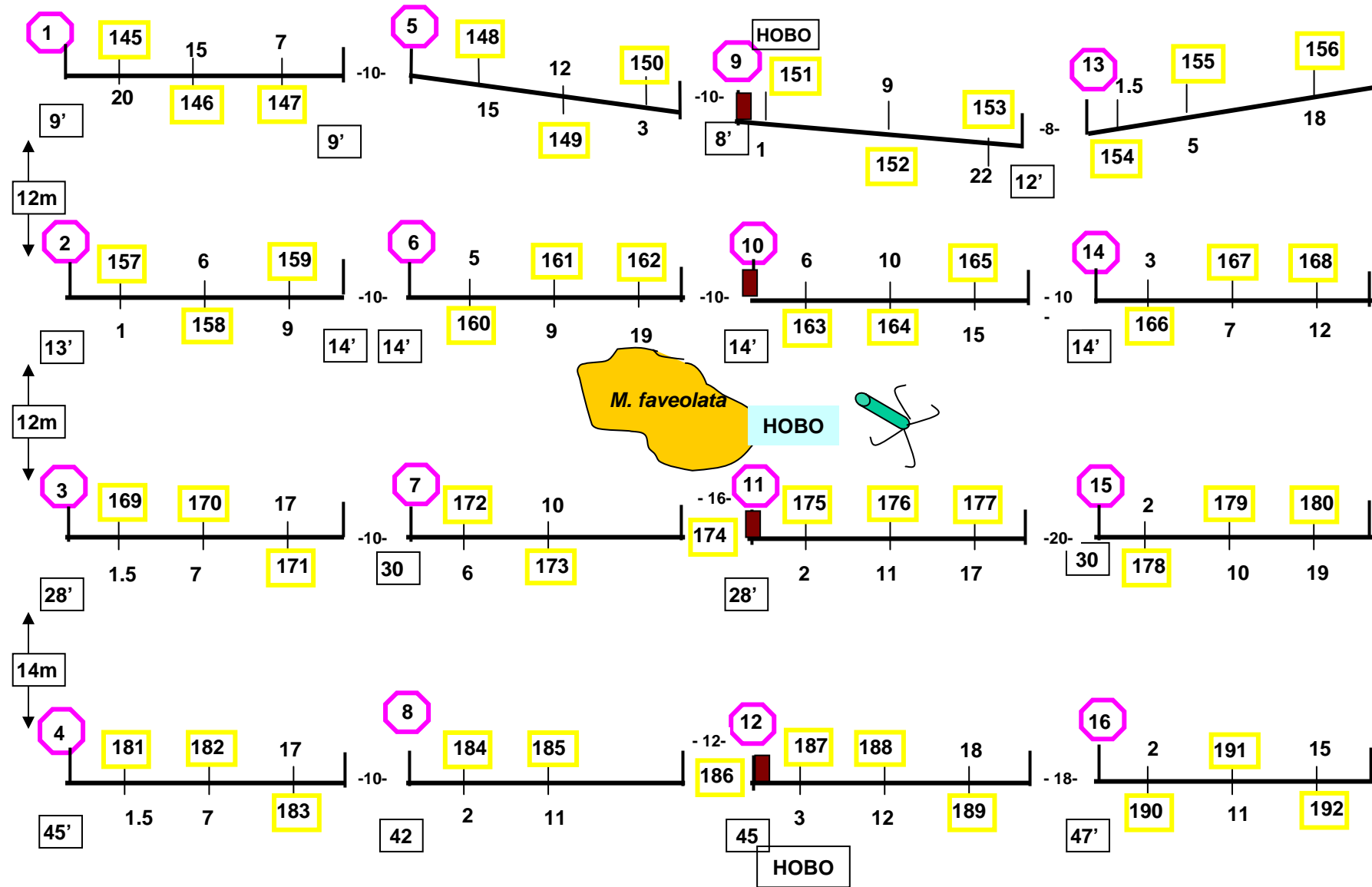


# SAMPLING DESIGN



# Turumote 17°56.097N / 67°01.130W

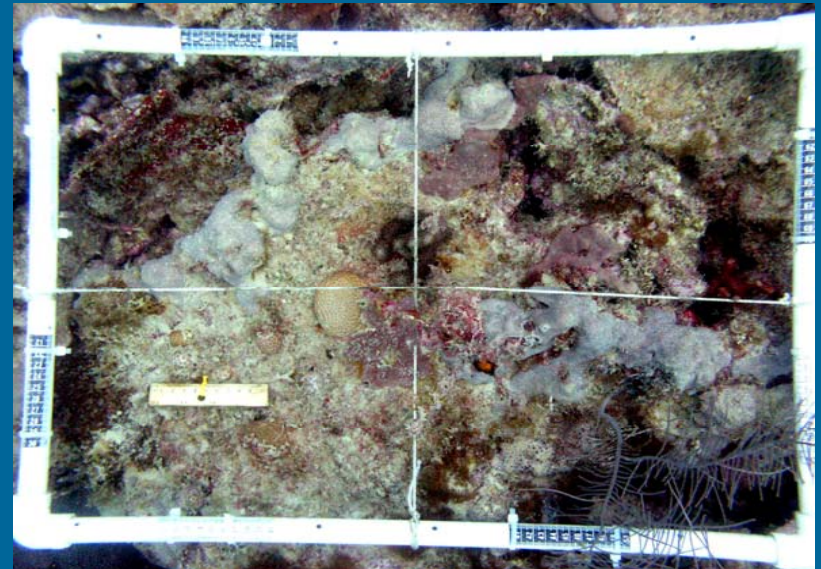
■ = Sediment traps





# Mortality/survivorship, distribution and composition

- Six permanent quadrats of 0.25 m<sup>2</sup> (0.61 m x 0.42 m) were marked along each of the four depth intervals (n= 96 permanent quadrats per reef).



- Four photos of the remaining quadrant were taken.
- Observed recruits were measured with a measuring stick attached to a piece of rebar.



*S. siderea*

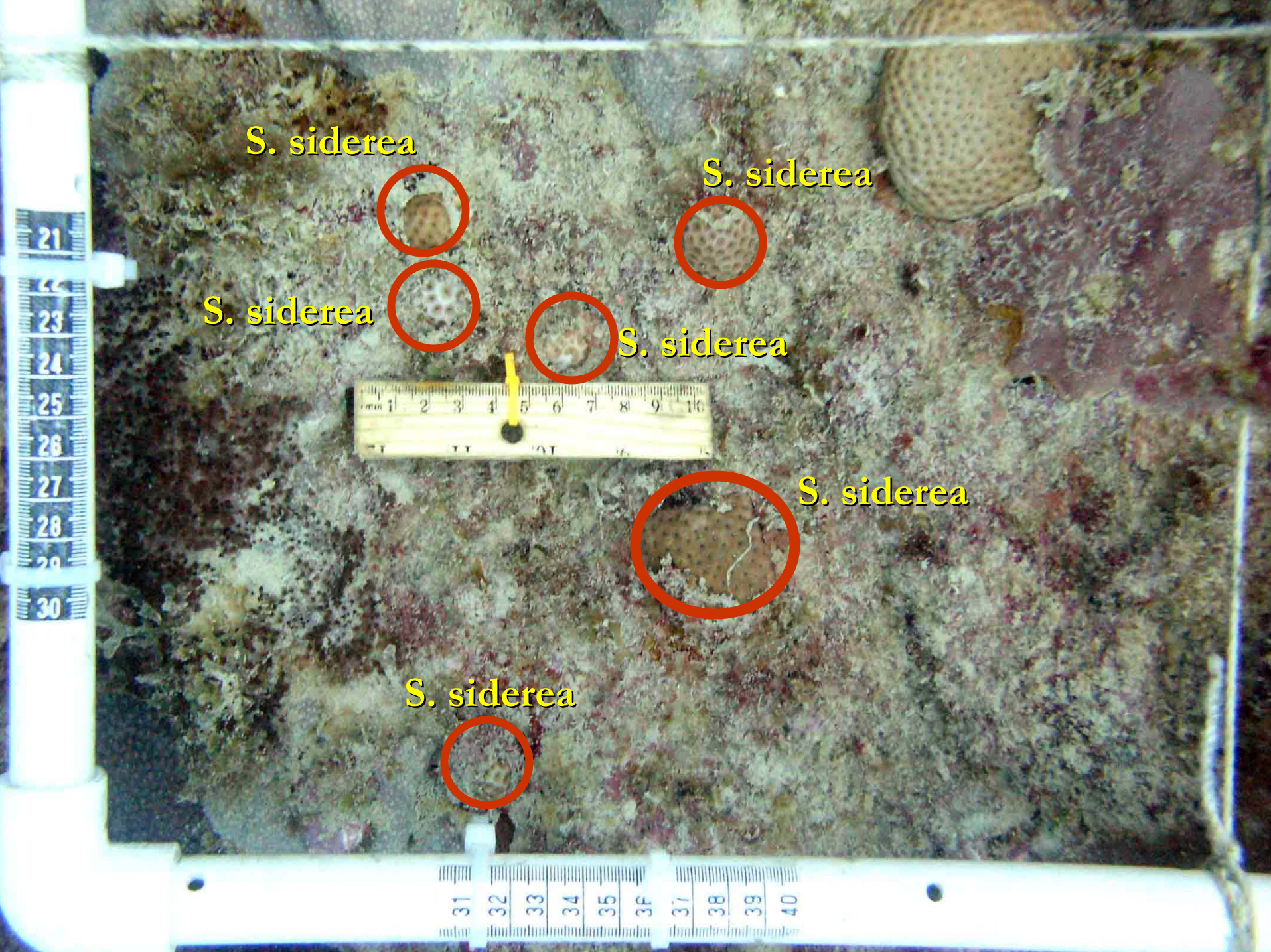
*S. siderea*

*S. siderea*

*S. siderea*

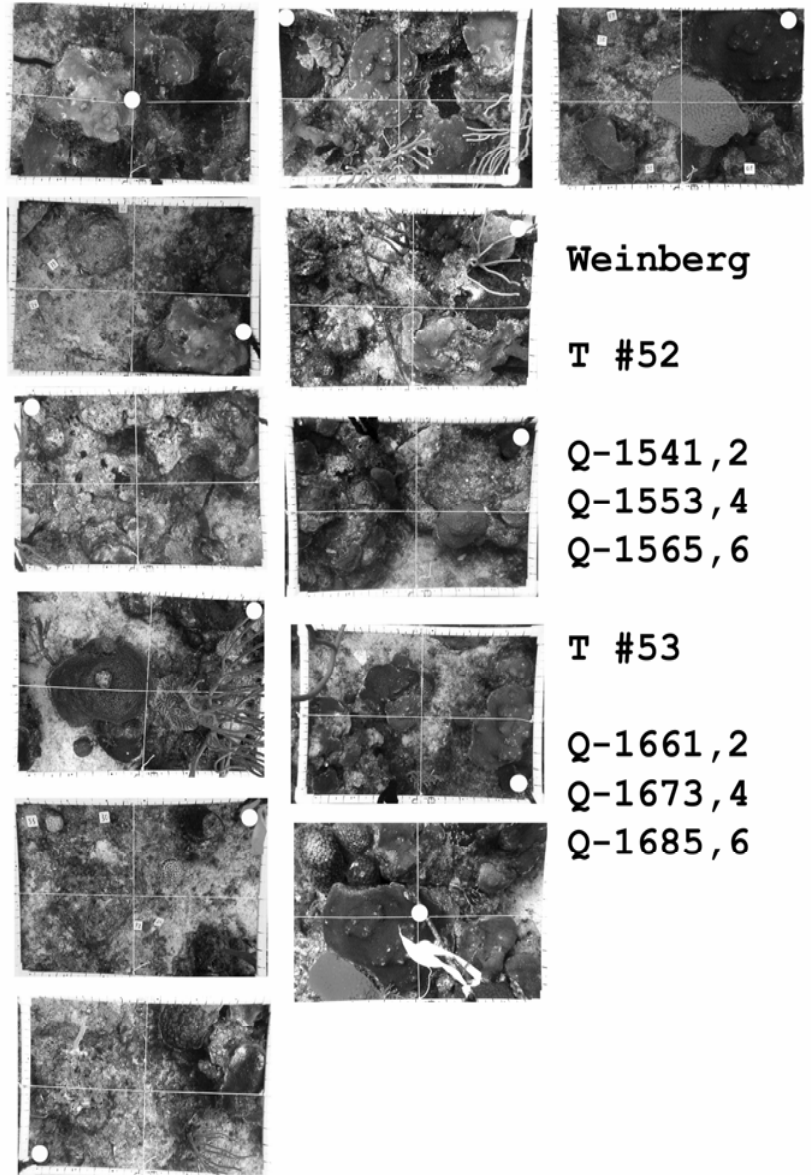
*S. siderea*

*S. siderea*



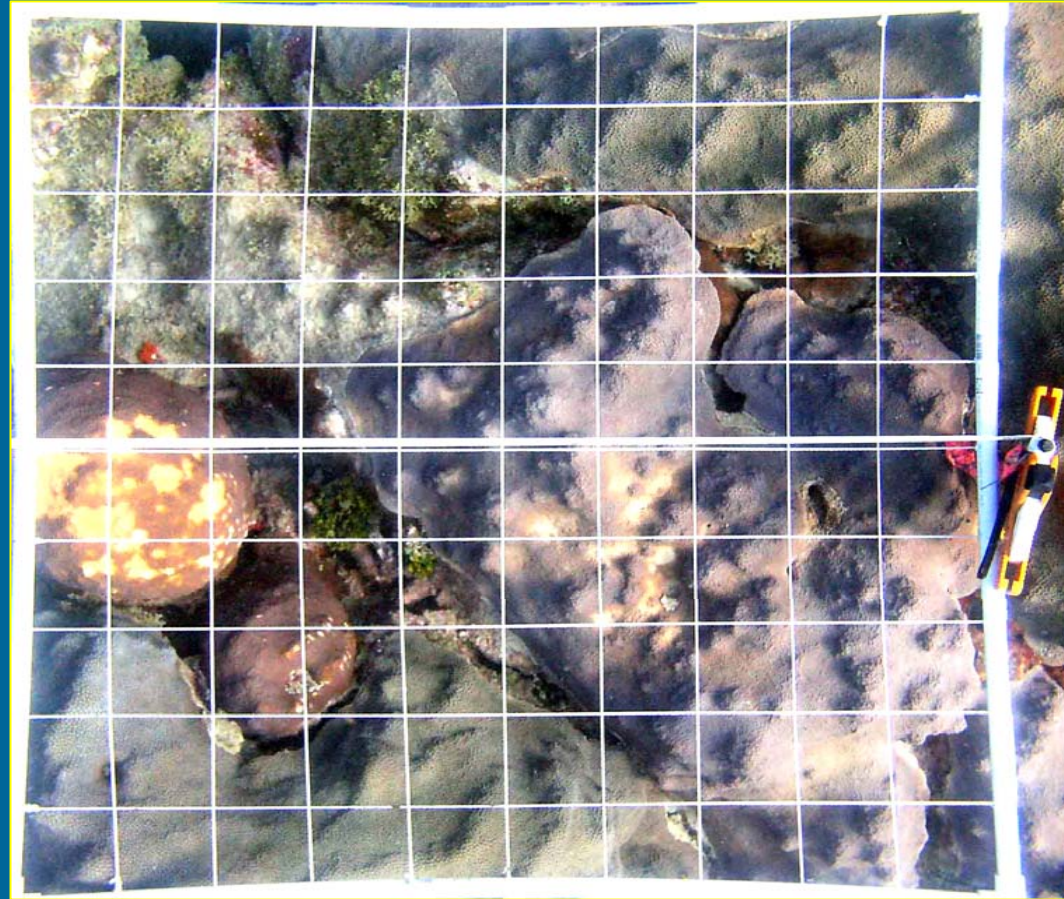


➤ Position of the quadrat mapped underwater, were transferred to a digital photo program where each photo was analyzed in detail for juvenile coral colonies. Afterwards, each set of maps was laminated to follow through time.



# Coral cover and juvenile abundance

- Six 1-m<sup>2</sup> quadrats divided on 100 areas of 10 cm<sup>2</sup> was randomly placed and surveyed along four permanent transects at each depth. (N= 96 per reef)
- In each quadrat coral cover, abundance, and juvenile colonies of each of the main coral species was measured.

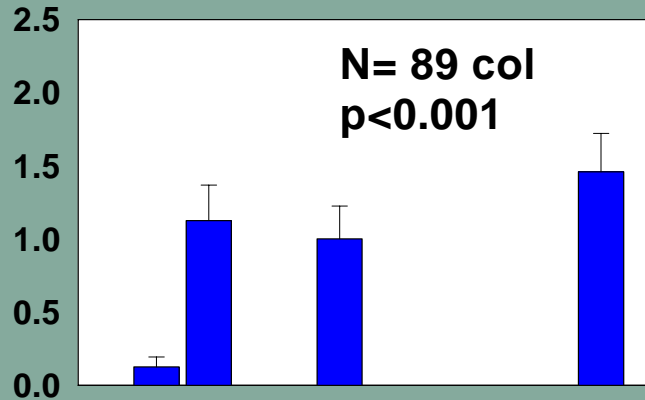




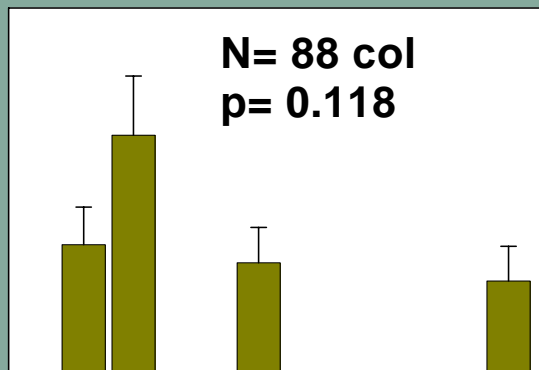
# Mean density (SEM) of juvenile coral colonies within reef site among depth intervals

Density of juvenile corals (col / 0.25m<sup>2</sup>)

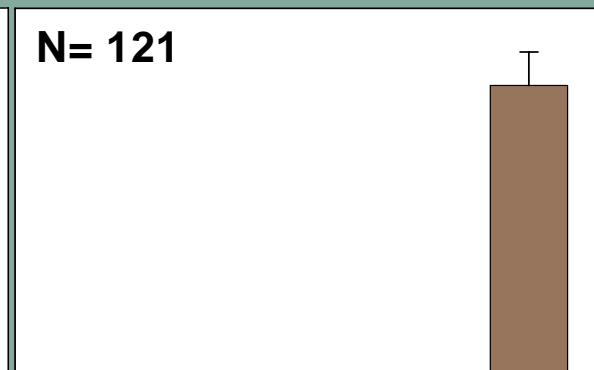
## Las Pelotas



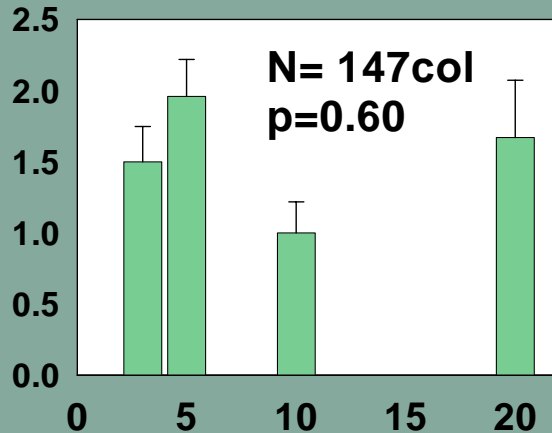
## Enrique



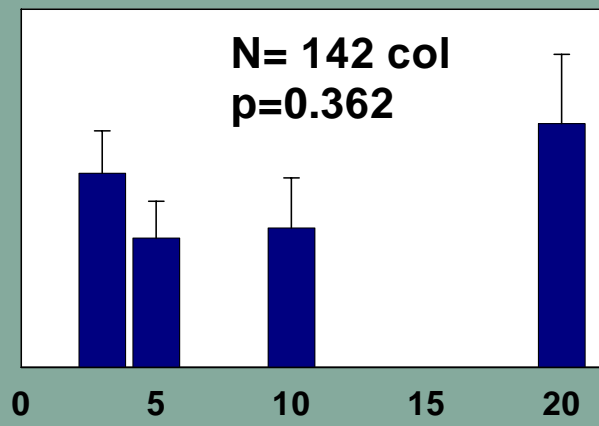
## El Hoyo



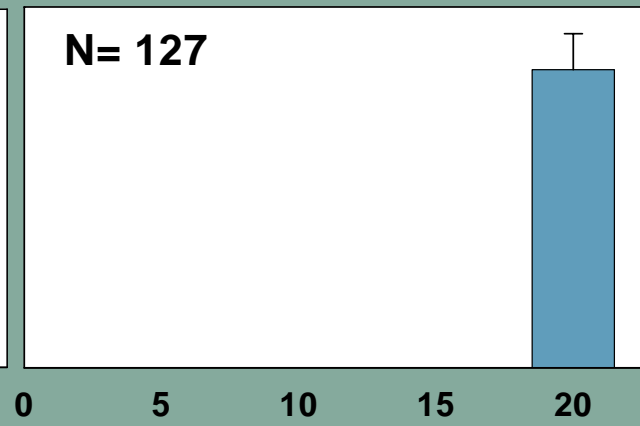
## Media Luna



## Turumote

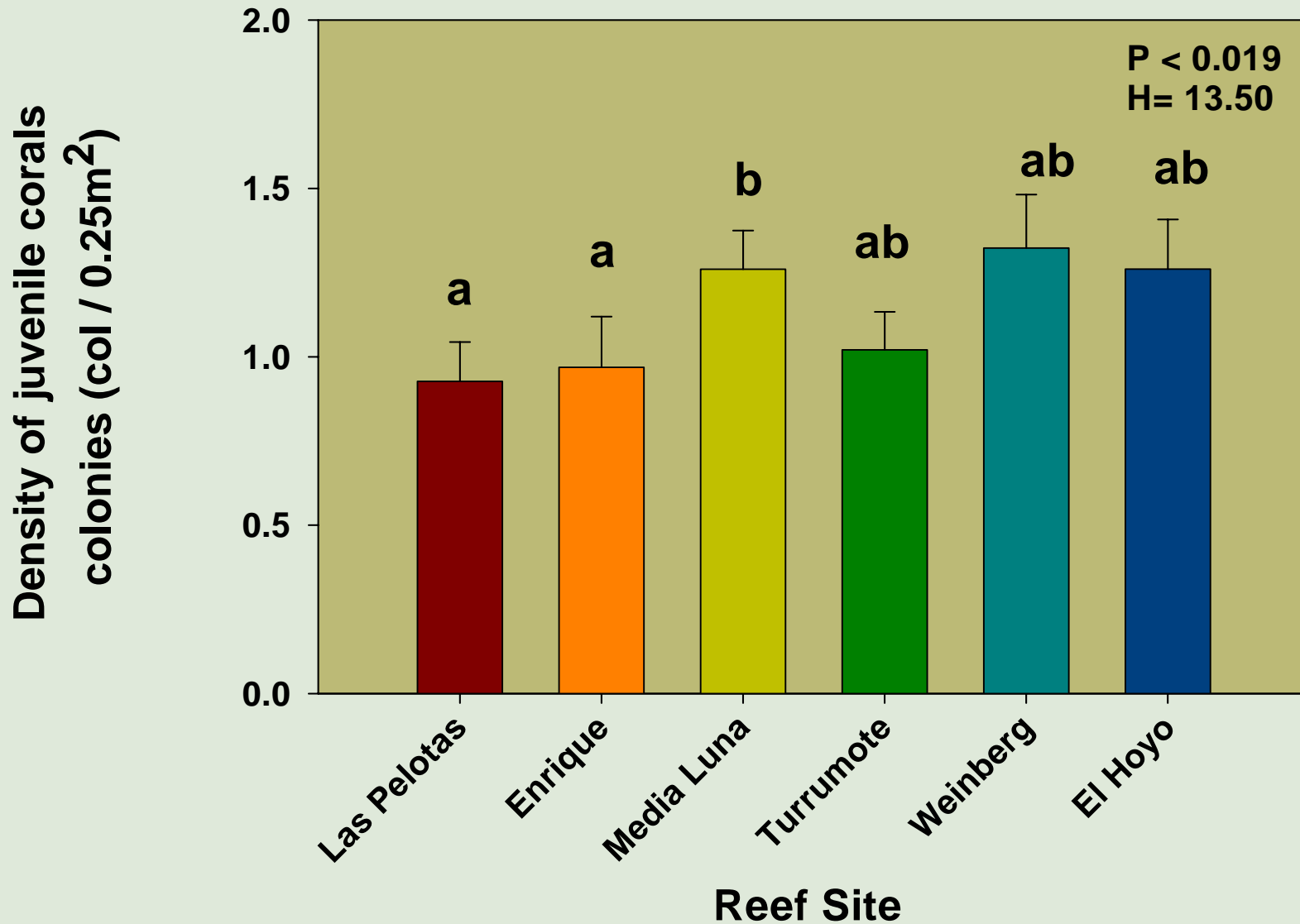


## Weinberg

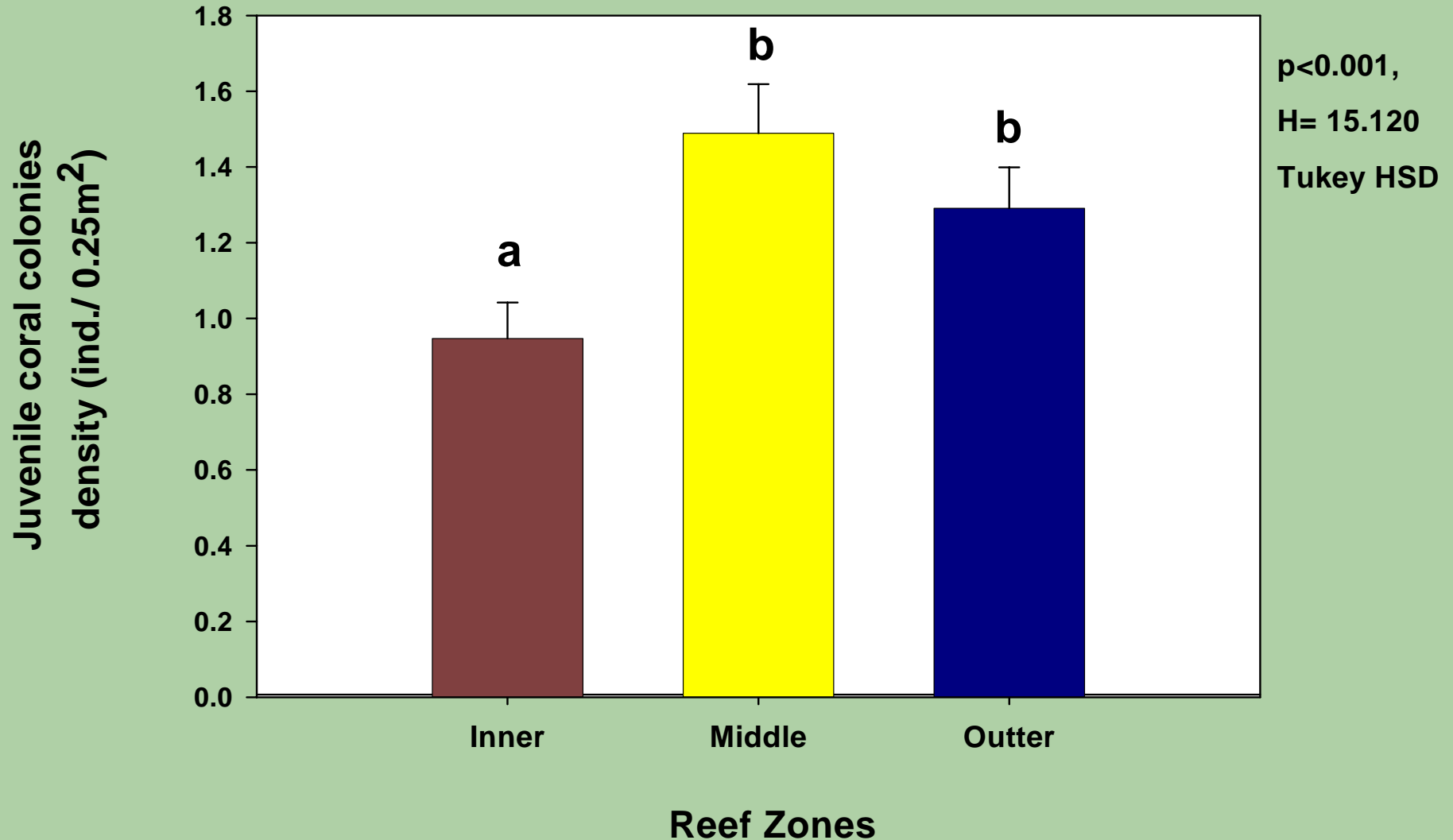


Depth (m)

**Mean density (SEM) of juvenile corals colonies  
at each of the reef site study**



**Juvenile coral density (MEAN + SEM)  
for the three reefs zones  
in the southwestern Puerto Rico**

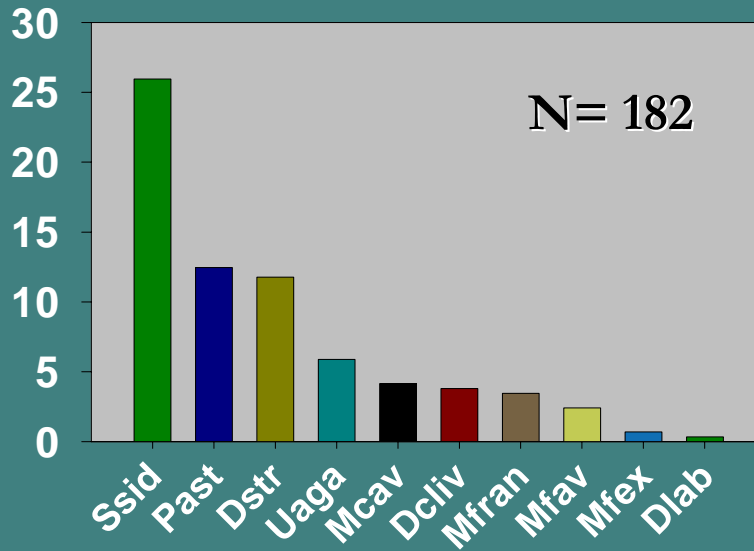




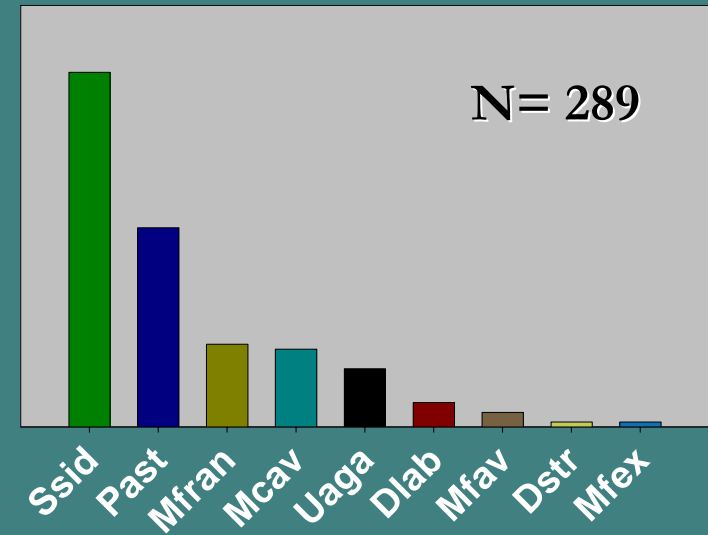
% Relative abundance of the most abundant species along  
an inshore-offshore gradient based on the total number of  
colonies for each zone

% Relative abundance of juvenile  
coral colonies

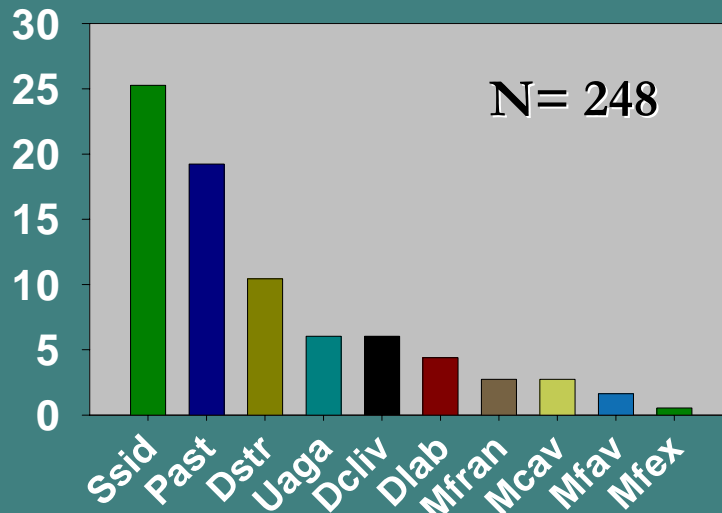
Inner-Shelf



Mid-Shelf



Outter-Shelf



# Summary

- Density of juvenile colonies was highest for shallow and intermediate depth.
- Among reef zone density differed significantly.
- Between 23 to 31 species of juvenile corals were present across reefs zones. Highest for the mid-shelf zone.
- Most common juvenile colonies were *S. siderea*, *P. astreoides*, *D. clivosa*, *D. strigosa*, *M. cavernosa*.
- *Siderastrea siderea* dominate most of the juvenile population among reef zone.

# Data to collect and analyze

- Finish second census for survivorship
- Analyze adult/juvenile ratio of the main species
- Analyze percent cover and juvenile abundance relation
- Analyze topographic complexity and juvenile survivorship

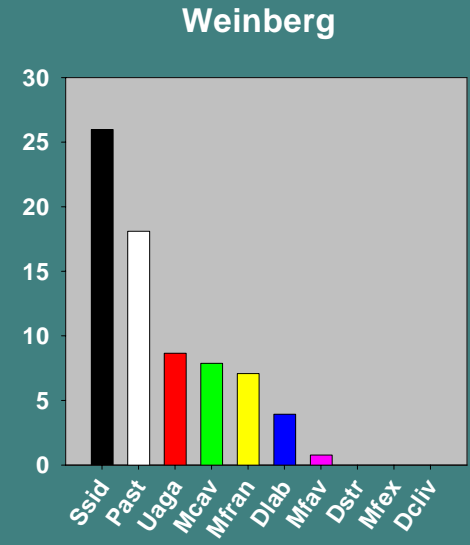
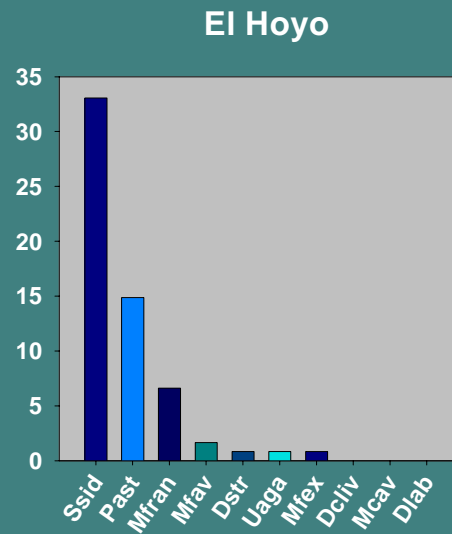
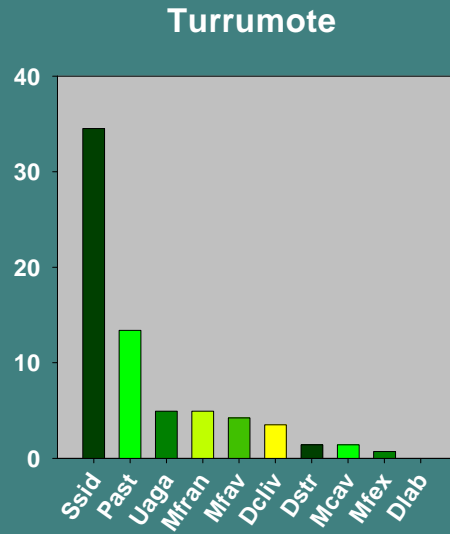
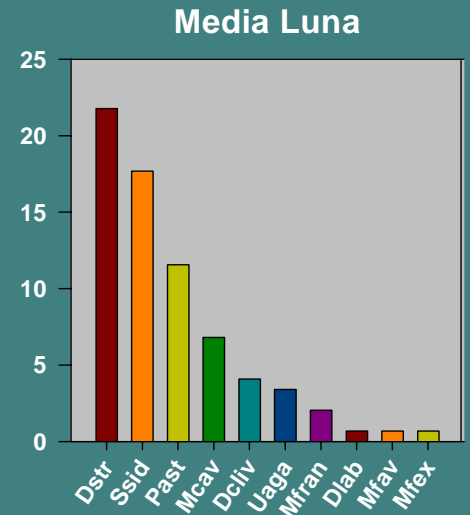
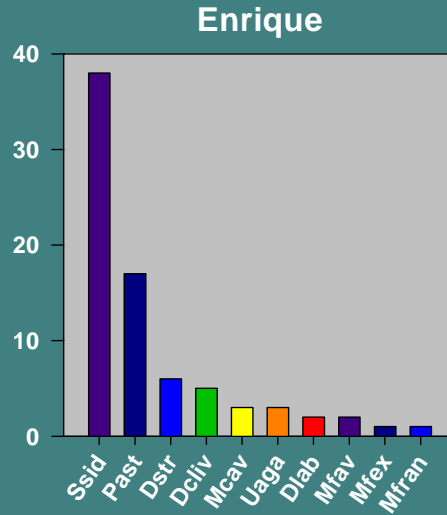
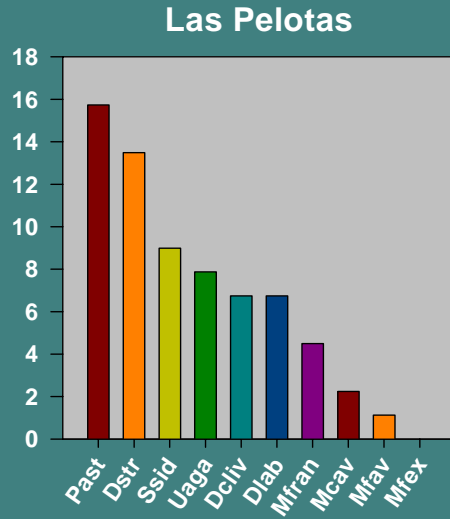




Questions?

# Distribution and relative abundance (%) of the main coral species for each of the reef site

% Relative abundance of juvenile coral colonies



Main speceis observed at each reef site

➤ Successful recruitment of new, sexually produced larvae is an important step in the life cycle of organisms (Richmond, 1991).

➤ Recruitment process can give valuable information on the reproductive potential of species for a given period of time. (Connell 1997; Yoshioka, 1996).

➤).

➤ However the majority of the studies carried on, have been done over artificial substratum which assessed successful settlement of the newly metamorphosed individual (Harrison and Wallace, 1990



**JUVENILES IN 0.25 m<sup>2</sup>**

**19 colonies  
8 species**





## **Coral recruits and juveniles**

- **Temporal and spatial variability in recruitment and mortality rates of corals.**





# Hypothesis

- Are there any significant differences between the abundance, composition and distribution of juvenile colonies and that of adult colonies among reef zones and between depth intervals within reefs?
- Are there any significant differences between the percent of coral cover and the composition, abundance and distribution of juvenile colonies among reef zones and between depth intervals within reefs?
- Are diversity, abundance, distribution, survivorship and juvenile/adult ratios correlated with the spatial heterogeneity?

# Introduction



E.I.S.



E.I.S.

## ➤ Coral reef distribution

- Tropical zones

## ➤ Reef corals, main builders of the carbonate framework

(Fargerstrom, 1983; Hatcher, 1997)

- Mass of large intergrown skeletal organisms
- Topographic relief above sea floor

## ➤ Coral reefs as diverse ecosystems

- Biodiversity

## ➤ Scleractinian corals are characterized by modular growth (Hughes and Jackson, 1985; Jackson and Coates, 1986)

- Iterative growth
- Function and survive alone when separate from the main colony





E.I.S.



➤ Important reef-building species like *M. complex*, *Diploria* genus have few juvenile representatives which contribute significantly to the growth and topographic complexity of coral reef ecosystems (Rogers et.al., 1984; Szmant, 1986)

➤ Currently no information exists on the abundance, composition and distribution of coral recruits for reefs in Puerto Rico.



# Materials and Methods

- Fieldwork was conducted in coral reefs off La Parguera southwestern Puerto Rico. The study includes six coral reefs in a transect from inner-shore to offshore.
- Two reefs were selected at each of three locations from the coast to the drop off area, the inshore (e.g. Pelotas and Enrique), mid-shelf (e.g. Media Luna and Turrumote), and the platform edge (e.g. Weinberg and El Hoyo) .
- This distribution allowed for comparisons in distribution, diversity, abundance of juvenile corals, survivorship and the ratio of juvenile to adult colonies in the major coral species.

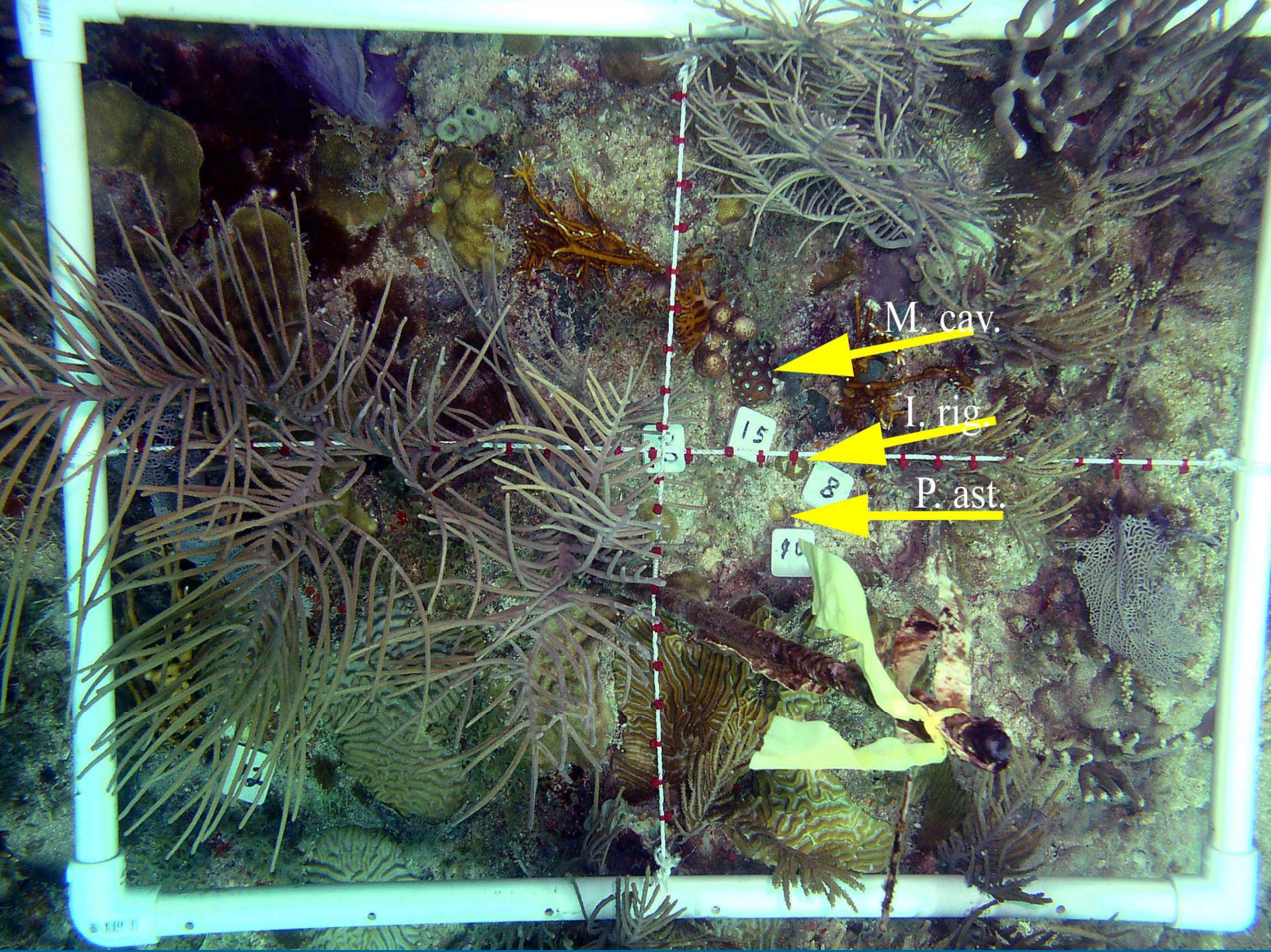
➤ Every time a juvenile was found, careful observation of its surroundings was made to secure that it was a new recruit/juvenile.

➤ For these, several characteristics were observed to differentiate juveniles from remnant tissue of extended partial mortality of a colony (Szmant, 1986; Chiappone and Sullivan, 1997).

- *Montastraea* sp. isolated crust of tissue less than 5 cm in diameter.
- *P. astreoides* and *S. siderea* isolated colonies less than 2 cm in diameter.





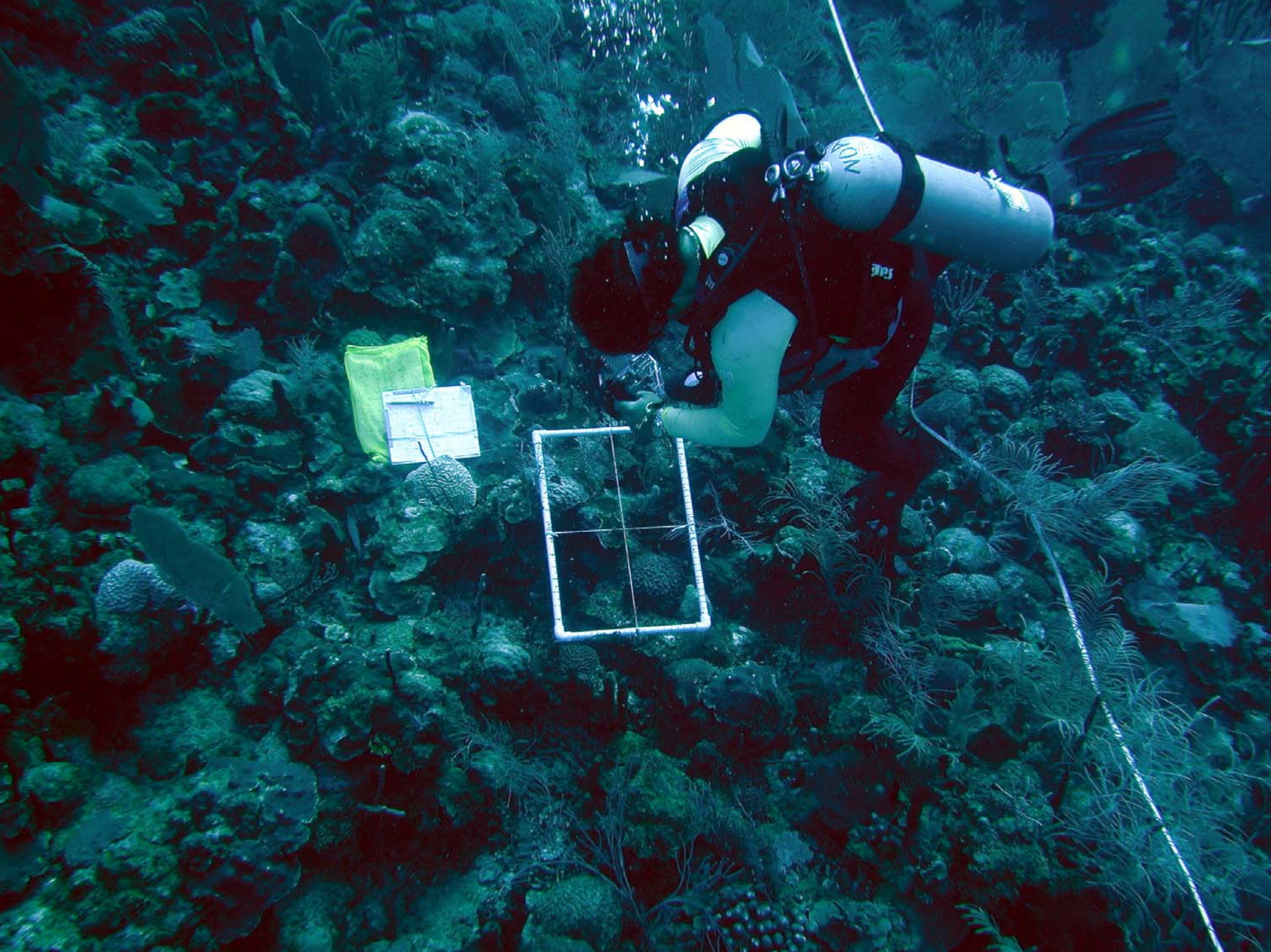


M. cav.

I. rig.

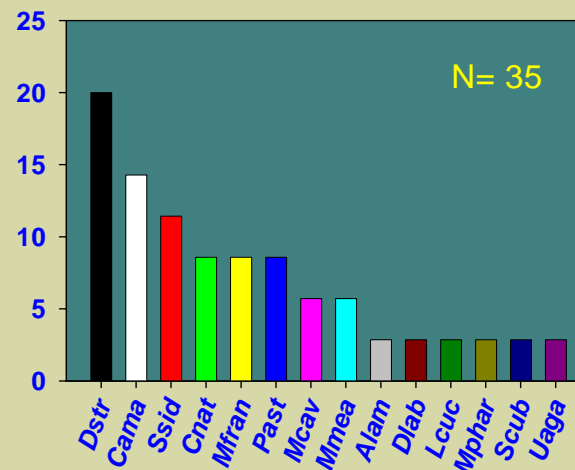
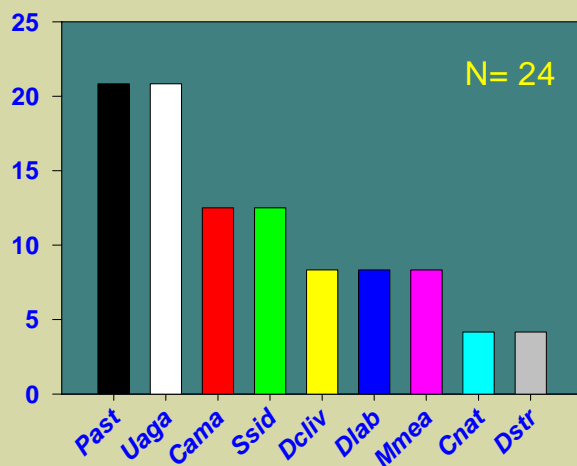
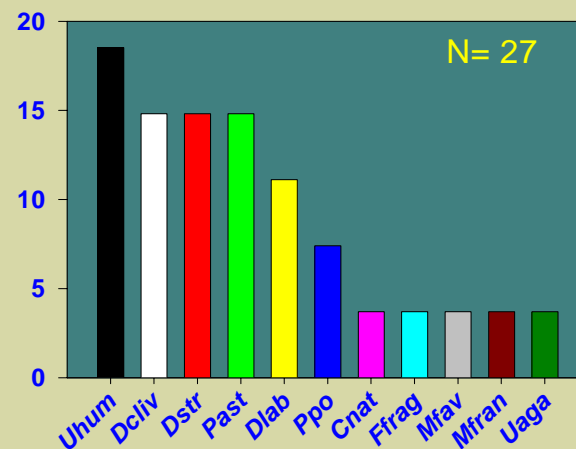
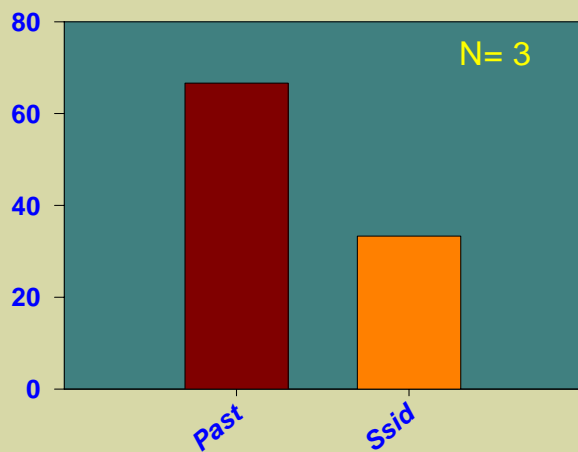
P. ast.





**Distribution of juvenile coral species observed (relative abundance)  
at four depth intervals (1) = 3m, (2) = 5m, (3) = 10m, (4) = 15m  
based on the total number of colonies (N) in Las Pelotas reef site**

**% Relative abundance of juvenile colonies**



# Experimental design

Coral cover and juvenile abundance, composition and distribution

